



Lesson 9: How do whales stay warm?

Objectives: Students will investigate the roles that insulation (blubber) and body shape/size play in preventing heat loss in marine mammals.

You will need:

For blubber glove:

- two 1-gallon zipper-seal bags
- 1 large container shortening
- duct tape
- small bucket or dishpan
- ice
- water

For oatmeal labs:

- 3 cups cooked oatmeal per group of 4-5 students
- 1/2 cup and 1 cup measuring cups
- Spoons
- Wax paper (4 approximately square sheets per group of students)
- Thermometers (2 per group of students)
- Data sheets (pages 9-7 to 9-9)—one of each per group of students
- Pieces of masking tape (about 6" long)—4 per group of students
- Paper towels
- Copies of activity page (page 9-10)—one per student.

Standards: CCSS.Math.Content.4.OA.A.2; CCSS.Math.Content.4.MD.A.2

Sunshine State Standards: SC.4.L.16.2; SC.4.P.11.1

Comment: The blubber glove activity in this lesson is also an optional activity in the 3rd grade manatee curriculum designed by the same authors. If a school is using both curricula, 4th grade students may already have been exposed to the blubber glove.

Vocabulary: hypothermia, blubber

Strategy:

Ahead of time (can be done days or weeks in advance):

1. Make a blubber glove. To do this, take two 1-gallon plastic bags. Fill one bag about half-way full with shortening, trying to keep the shortening all in the bottom of the bag. Take the second gallon bag, and put it inside the first bag, so the shortening is sandwiched between the two bags. Be careful not to push shortening out of the top of the bags! Use duct tape to seal the openings of the two bags together. DO NOT seal the two sides of the inside bag together!

**Before class:**

2. Put water into a bucket, dishpan or similar container. The water should be at least 6" deep, but do not fill the container too full or water will get spilled during the activity.
3. Cook some oatmeal (3 cups per group of 4-5 students). Keep it warm in a crockpot set on low. It should be fairly thick.

During class:

4. Explain to students that today's lesson will investigate how whales manage to stay warm even if they live in very cold water. Ask the students how they stay warm when it is cold [*Answers might include wearing a jacket, hat or gloves, staying inside with the heater on, drinking hot chocolate, etc.*] Ask if whales can use any of these same strategies [*No*]. So how do whales stay warm? [*Some students may know about blubber, which is one correct answer.*]
5. Ask the students if any of them have ever felt cold when they were swimming, even on a warm day. Explain that human body temperature is about 98.6 degrees Fahrenheit or 37 degrees Celsius. This is similar to the body temperature of whales and dolphins. If the water temperature is cooler than our body temperature, the heat from our body will be drawn into the water to try and equal out the temperature between the water and our body. In water, this heat transfer is about 25 times faster than in air, so people will get hypothermia faster in cold water than in cold air. Hypothermia occurs when a person's body temperature falls below 95 degrees Fahrenheit. It causes the body's organs to be unable to work properly, and can result in death.
6. So, for a warm-blooded animal that lives its entire life in water, heat loss is something that the animal needs to be able to prevent. Explain that the class will get to feel how it is that blubber helps to keep the whale from losing body heat. Add ice to one of the two containers of water. Show the students the blubber glove, and explain that the shortening in the glove will act like blubber to help keep their hands warm in cold water.
7. Place the bottom of the blubber glove into the ice water. Invite a student to put one hand inside the blubber glove. Ask them to put their other hand into the ice water without the blubber glove. Let each student try this. In between students, you may need to redistribute the shortening so there is an even layer between the bags.
8. Explain to the students that the blubber is important in helping keep whales warm, but that their body shape also helps keep them warm.
9. Explain that the class is going to do some experiments to look at how body size and shape can affect heat loss. These two experiments combined take about 45 minutes. You may wish to have half of the class do the first experiment and the other half do the second experiment. The activity sheet on page 9-10 can be used to help keep students busy when they are not actively conducting an experiment.
10. Divide the class into groups of 4-5 students.
11. Give each group two thermometers, a stopwatch, two data sheets and two pieces of wax paper.



12. Assign students roles (two are temperature readers, one is timekeeper and one or two are data recorders). Ask the students to record the room temperature on the data sheets.
13. Explain that you will be giving each group two portions of oatmeal.
14. Demonstrate that they will use the wax paper to make one portion into a ball, and one into a flattened disk about a half-inch in thickness. Explain that they will need to do this quickly; then show them how to stick the tip of a thermometer into each of the oatmeal shapes and record the temperatures. The thermometer should be inserted into the center of the oatmeal. Explain that they will leave the thermometer in place, and read the temperatures every minute. It will be easiest if the students use masking tape to hold the wax paper and thermometer in place. The timekeeper will call out each minute, the temperature readers will read off the temperature, and the data recorders will record the temperatures on the data sheet.
15. Ask each group to complete the hypothesis on their data sheets (fill in the blank with either the word “round” or “flat”).
16. Give each group $\frac{1}{2}$ cup of oatmeal on each of their sheets of wax paper, and tell them to begin (each group should start as soon as they get their oatmeal.)
17. Once both of the lumps of oatmeal have cooled to room temperature (or after 15 minutes, whichever comes first), have the students remove the thermometers and set them aside. They should throw their wax paper and oatmeal in the trash, and come and get two more pieces of wax paper and two new data sheets.
18. When all groups have completed the first oatmeal experiment, discuss the results. Which oatmeal shape cooled the fastest? See if the students can come up with an explanation as to why the flatter shape cooled more quickly. Remind them that both shapes cooled because the heat from the oatmeal flowed into the air to try and equal out the temperatures between the air and the oatmeal. The flatter shape cooled faster because the heat had a shorter distance to travel to get from the middle of the oatmeal to the air.
19. Explain the second oatmeal experiment. In this experiment, the students will get two different sized portions of oatmeal. They will shape both into balls, using the wax paper as before. They will again record the temperatures in the center of the oatmeal over time. Reassign student roles if desired.
20. Ask the students to form a hypothesis for this experiment (the hypothesis should answer the question, which ball, the small one or the large one, will cool the fastest?)
21. Give each group of students a $\frac{1}{2}$ -cup portion of oatmeal on one piece of wax paper and a 1-cup portion on the other. Have them begin the experiment. Note that they will record the temperatures every five minutes for this experiment. If possible, have the time keeper use the countdown feature of the stopwatch as an “alarm” every 5 minutes.
22. After 30 minutes, have the students remove the thermometers, wipe them with a damp paper towel and set them aside. They should throw their wax paper and oatmeal in the trash.
23. When all groups have completed the second oatmeal experiment, discuss the results. Which oatmeal shape cooled the fastest? The smaller ball should have cooled the fastest, for the same reason as in the first experiment.



24. Ask the class to come up with the best body size and shape for an animal that lives in very cold water (large and round—to conserve energy loss).

References:

- Experiments modified from “Cool shapes” activity by Sea World—*Arctic Animals 4-8 Teacher’s guide*.



STUDENT INSTRUCTIONS

OATMEAL LAB #1

1. Data recorder #2: read the room temperature off one of the thermometers and record it on both data sheets.
2. Timekeeper: Use the wax paper to gather up one portion of oatmeal into a ball
3. Data recorder #1: Use the wax paper to shape the other portion of oatmeal into a disk that is about ½” thick. The thick line at the right side of this paragraph is ½” long.
4. Temperature reader #1: Place the tip of one thermometer into middle of the oatmeal ball. Read off the temperature. Use a piece of masking tape to gather the wax paper around the thermometer and hold it in place.
5. Data recorder #1: write down the temperature in the correct space on the data sheet.
6. Timekeeper: start the stopwatch.
7. Temperature reader #2: Place the tip of the second thermometer into the middle of the oatmeal disk. Read off the temperature. Use a piece of masking tape to gather the wax paper around the thermometer and hold it in place.
8. Data recorder #2: write down the temperature in the correct space on the data sheet.
9. Timekeeper: call out each minute. Repeat steps 4, 5, 7, 8 and 9 until you have made observations for 15 minutes.
10. Wipe off the thermometers and set them aside. Throw your oatmeal and wax paper into the trash.
11. See your teacher for more wax paper and new data sheets.



STUDENT INSTRUCTIONS

OATMEAL LAB #2

1. Timekeeper: Use the wax paper to gather one portion of oatmeal into a ball
2. Data recorder #2: Gather the other portion of oatmeal into a ball.
3. Temperature reader #1: Place the tip of one thermometer into the middle of the small oatmeal ball. Read off the temperature. Use a piece of tape to hold the thermometer and wax paper in place.
4. Data recorder #1: write down the temperature in the correct space on the data sheet.
5. Timekeeper: start the stopwatch.
6. Temperature reader #2: Place the top of the second thermometer into the middle of the large oatmeal ball. Read off the temperature. Use a piece of tape to hold the thermometer and wax paper in place.
7. Data recorder #2: write down the temperature in the correct space on the data sheet.
8. Timekeeper: call out every 5 minutes. Repeat steps 4, 5, 7, 8 and 9 for a total of 30 minutes.
9. Wipe off the thermometers with a damp paper towel and set them aside. Throw your oatmeal and wax paper into the trash.



Student names: _____

Data sheet Oatmeal lab 1

Hypothesis: We think that the _____ (round or flat?) oatmeal will cool the fastest.

The air temperature is _____ °F (_____ °C)

Time	Temperature of round ball of oatmeal	Temperature of flattened disk of oatmeal
Initial reading		
1 minute		
2 minutes		
3 minutes		
4 minutes		
5 minutes		
6 minutes		
7 minutes		
8 minutes		
9 minutes		
10 minutes		



Time	Temperature of round ball of oatmeal	Temperature of flattened disk of oatmeal
11 minutes		
12 minutes		
13 minutes		
14 minutes		
15 minutes		

1. What was the total change in temperature for
 - a) The round ball of oatmeal? _____
 - b) The flattened disk of oatmeal? _____
2. Which one cooled the fastest (lost the most heat)—the round ball or the flat disk? _____



Student names: _____

Data sheet Oatmeal lab 2

Hypothesis: We think that the _____ (small or large?) ball of oatmeal will cool the fastest.

The air temperature is _____ °F (_____ °C)

Time	Temperature of small ball of oatmeal	Temperature of large ball of oatmeal
Initial reading		
5 minutes		
10 minutes		
15 minutes		
20 minutes		
25 minutes		
30 minutes		

- What was the total change in temperature for
 - The small ball of oatmeal? _____
 - The large ball of oatmeal? _____
- Which one cooled the fastest (lost the most heat)—the small ball or the large ball? _____



Activity Sheet

Name: _____

Did you know...? A bowhead whales' blubber can be 17-19 inches thick! One inch = 2.5 centimeters. How many centimeters thick is a bowhead whale's blubber? _____

How many new words can you make from the letters BOWHEAD WHALE? Try to come up with at least as many words as there are numbered spaces in the table. You can write down more than the numbered amount of words if you can think of them!

2-letter words	3-letter words	4-letter words	Words with more than 4 letters
1.	1.	1.	1.
2.	2.	2.	2.
3.	3.	3.	
	4.	4.	
	5.	5.	



Answers for activity sheet

A bowhead whale's blubber is 42.5 to 47.5 cm thick.

Suggested words from BOWHEAD WHALE. Note that this is not an exhaustive list of words:

Abode	Deal	Lead
Adobe	Dew	Led
Ah	Doe	Lee
Aha	Eel	Low
Ale	Had	Ode
Awe	Hale	Owe
Awed	Haw	Owed
Awl	Hawed	Owl
Bad	He	Wade
Bawl	Head	We
Be	Heal	Wean
Bead	Healed	Weaned
Bed	Heed	Web
Bee	Heel	Weed
Bow	Hew	Weld
Bowed	Hewed	Wheel
Bowl	How	Who
Bowled	Howl	Wow
Dab	Howled	Wowed
Dale	Law	